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January 2005

Ribose : A Key to Heart Health and Energy

An interview with John St. Cyr, M.D., Ph.D.

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During our series of discussions with cardiologist Stephen Sinatra, M.D., I was intrigued to find that Dr. Sinatra had expanded his "Twin Pillars of Heart Heath," coenzyme Q-10 and L-carnitine, to include ribose (D-ribose), another nutrient that energizes the powerhouses of cells, the mitochondria. The twin pillars became a "Triad," and Dr. Sinatra stated that this triad would be the new frontier for metabolic cardiology.

While I was certainly aware that ribose is a regulator in the production of the energy storehouse, adenosinetriphosphate (ATP), I was not aware of the new research showing that supplemental ribose helps the heart rebuild and maintain energy in hearts having sub-optimal blood supply. I thought that you might appreciate more information on the basics of ribose, so let's chat with ribose expert, Dr. John St. Cyr.

John St. Cyr, M.D., Ph.D. is a leading expert in cardiac metabolism and has been involved in ribose-based cardiovascular research since the mid-1980s. Trained as a pediatric cardiovascular surgeon, Dr. St. Cyr has a strong background in biochemistry and physiology. He has published more than 60 peer-reviewed scientific research articles and has presented his research at more than 35 national and international medical meetings. Dr. St. Cyr received his Master of Science degree in physiology before going on to complete both his M.D. and Ph.D. degrees from the University of Minnesota. For his Ph.D. research, Dr. St. Cyr studied the effect of ribose on ischemic hearts (hearts deficient in oxygen due to reduced blood flow). He currently is a full-time clinical consultant and scientific adviser.

Passwater: Dr. St. Cyr, what drew you to your field of research?

St. Cyr: There is a history of physicians in my family, so health and healing have always been my calling. When I entered medical school I was attracted to cardiovascular surgery, so that was the path I followed. My particular interests have evolved around finding new ways to promote health and wellness. I have always been most motivated by the discovery that comes from research, so that is the direction I have chosen. Cardiac metabolism and the impact it has on disease has been the focal point of my research, and that is what brought me

to ribose.

Passwater: How did you become involved with ribose?

St. Cyr: For my Ph.D. research in the mid-1980s I worked in the lab of Dr. John Foker, a very well known pediatric cardiovascular surgeon at the University of Minnesota. At the time, Dr. Foker was looking into various aspects of heart metabolism. I became interested in the function of a seldom-studied metabolic pathway, called the pentose phosphate pathway, that is crucial to energy metabolism in tissue. This is the pathway used by the body to make ribose from glucose.

It became clear from my research, and from that of my colleagues, that energy metabolism was crucial to cardiac function in diseased hearts. Through our collective research we determined that the relaxation phase of the heart is most affected by loss of cellular energy. And, if the heart cannot relax properly, it cannot fill with blood for the next heartbeat.

Our research showed that ribose is the limiting factor in cardiac energy synthesis. Without ribose, hearts simply cannot maintain the energy levels they need to function normally. We also determined that hearts do not have the metabolic machinery they need to make ribose when they are metabolically stressed, but by giving ribose to sick hearts we could help them recover both their energy levels and function.

Passwater: What are the health benefits of ribose?

St. Cyr: Ribose is a simple, safe, all natural five-carbon sugar that is made by every cell in the body. It is the only compound used by the body to regulate the metabolic pathways used to make a class of compounds known as nucleotides. Nucleotides provide the foundation for many very important compounds including ATP, the genetic material DNA and RNA, the vitamin riboflavin, and a group of compounds known as cofactors that are used in cellular signaling.

Research has shown that ribose administration is effective in treating heart and muscle disease, accelerating tissue recovery following strenuous exercise, preserving blood that has been harvested for transfusion, reducing fatigue and myalgia, aiding in the diagnosis of coronary artery disease, and a number of other conditions. What these all have in common is the need for cellular energy or energy recovery. Ribose is extraordinarily effective in accelerating tissue energy synthesis.

Passwater: How does ribose do this?

St. Cyr: The study of cellular energy is called bioenergetics. Bioenergetics takes into account all the mechanisms used by the cell to make and use energy. When we think of cellular energy metabolism we must take into account two important elements – the total concentration of energy in the cell and the ability of the cell to turnover, or recycle, its energy supply. Ribose is the compound used by the body to regulate the amount of energy in the

cell. It is the only compound that can perform this important function.

When cells become stressed by disease, exercise, or metabolic disturbance the pool of energy in the cell shrinks. As the pool becomes smaller, cellular function is lost. Muscle cells remain tense and sore, cells are unable to synthesize proteins and other large molecules that need a lot of energy in their formation, and the ion balance of cells is disrupted.

No matter how well the cell recycles energy, through glycolysis or the oxidative pathways of energy metabolism, cellular energy supply cannot keep pace with demand. Maintaining a healthy energy pool is critical to cellular function.

Ribose is the fundamental building block of ATP, so without sufficient ribose in the cell, ATP cannot be formed. If ATP cannot be formed the energy pool cannot be resupplied if the cell becomes energy starved.

Passwater: You mentioned that ribose was a sugar. To some of our non-biochemist readers, sugar may sound undesirable as in the case of too much table sugar.

St. Cyr: Ribose is unique among sugars. Let me explain why.

The body uses sugars in four basic ways. First, sugars are used by the body to fuel energy recycling down a metabolic pathway called glycolysis. These sugars are frequently called "bad" sugars, and include sugars such as table sugar (sucrose), blood sugar (glucose), and others. Too much of these sugars can be a definite problem, but they are important metabolic constituents nonetheless.

Second, sugars are used to store energy substrates. Glycogen is a chain of glucose molecules that stores them in the cell for future use when energy is needed.

Third, sugars are used in complex molecules to support cell structure. A class of compounds called glycoproteins combine sugars with proteins giving strength to cell walls and other cellular structures.

Finally we come to ribose. Ribose is the only sugar used by the body to regulate the metabolism of nucleotides. Ribose is not used to fuel energy recycling like the "bad" sugars. Instead, it drives the process of energy recovery by actually making energy compounds and keeping them in the cell. Only ribose performs this very vital cellular function.

Passwater: What are some of the studies that have gotten cardiologists such as Dr. Sinatra excited about ribose?

St. Cyr: A Pub-Med search of the scientific literature will show over 15,000 peer-reviewed studies involving ribose. Most of these have to do with the involvement of ribose in important cell signaling compounds. From a basic scientist's perspective these are exciting.

However, what really excites cardiologists and physiologists are studies that show the more

direct benefits of ribose on cardiovascular and muscle health. For example, a new study that is not even published yet has shown that ribose improves oxygen utilization efficiency in congestive heart failure patients. This is very important because the efficiency of oxygen utilization is a strong predictor of morbidity and mortality in this patient population.

Other studies show that ribose improves diastolic cardiac function, exercise tolerance, and quality of life in patients with coronary artery disease and congestive heart failure. Still other studies show that ribose increases the anaerobic energy reserve of healthy hearts.

In addition to hearts, several studies have looked at muscle health and recovery from athletic performance. Ribose shows a clear benefit here as well.

Passwater: Wasn't ribose of special interest to bodybuilders before the heart benefits became known?

St. Cyr: Actually, the cardiovascular benefits have been known for some time. However, because ribose was so expensive to produce, it was largely known only to clinical cardiologists researching the effect of ribose on diagnosing heart disease. Giving ribose to sick hearts wakes up certain segments of the heart that are said to be "hibernating." In other words, they are alive but not functioning. They do not function because they don't have enough energy. When ribose is given to these hearts, the energy level improves and those segments beat again. This is of particular importance to cardiologists instructing surgeons as to where blood flow should be plumbed during heart surgery.

Bodybuilders were the first in the supplement market to uncover the benefits of ribose, and it is used heavily in that group of athletes. However, the heart benefits have been known for several years.

Passwater: Does ribose help increase the overall energy in the body?

St. Cyr: Yes, virtually every cell in the body can benefit from ribose administration. The exceptions are the liver, adrenal cortex, mammary tissue, and adipose tissue. These tissues are able to make all the ribose they need. Unfortunately, they cannot make ribose and transport it to other tissues. Every other tissue in the body must make its own supply of ribose. As I mentioned earlier, these tissues lack the metabolic machinery to make ribose quickly when it is needed to restore cellular energy levels.

That's why it takes so long for cells and tissues to recover following metabolic or physical stress.

Many people who experience overwhelming fatigue and myalgia find that ribose makes their whole body feel better. Others, who become sore after a weekend run or cycle ride, find that ribose helps overcome soreness and the fatigue that can last for days following unaccustomed exercise.

Passwater: Do we get enough ribose in our diet or do we produce enough in our bodies?

St. Cyr: We get very little ribose in our diet. Although ribose is found in fairly good levels in red meat, the cooking process destroys the free ribose and makes it bind with proteins. Fruits and vegetables have little free ribose in their cells and do not contribute much to daily intake.

Every cell in the body has the capacity to make ribose. However, ribose is needed most when cells are metabolically stressed. But during these times the body would rather use glucose for energy recycling than for ribose synthesis. So during stress our bodies make little ribose. Cells that are stressed by disease, exercise, mitochondrial dysfunction, or other metabolic ailments can all benefit from ribose administration.

Passwater: How much ribose is recommended as a supplement? How is it taken? What forms of ribose should we look for?

St. Cyr: Ribose is available in many forms, such as powders, beverages, tablets, energy bars and other forms, so slight dosing adjustments may have to be made depending on the delivery form. However, because 95%-98% of ribose is absorbed, adjustments will really be minimal. I concur with Dr. Sinatra in recommending the following dosages:

*** 5 to 7 grams** daily as a preventative in cardiovascular disease, for athletes on maintenance and for healthy people doing strenuous activity.

*** 7 to 10 grams** daily for patients with cardiovascular disease, peripheral vascular disease, patients recovering from heart surgery or heart attack, for treatment of stable angina pectoris and for athletes working out in chronic bouts of high-intensity exercise.

*** 10 to 15 grams** daily for patients with advanced heart disease, patients awaiting heart transplant, and patients with dilated cardiomyopathy, frequent angina, fibromyalgia or neuromuscular disease.

Ribose is very easy to take, and smaller doses taken during the course of the day are very effective. Therefore, products containing smaller amounts of ribose are fine as long as we keep in mind the total daily dose we are looking for

Passwater: Are there more studies under way?

St. Cyr: I am aware of several studies that are currently in progress and/or in development. One multi-center study is continuing to investigate the benefits of ribose in patients with congestive heart failure. Another is investigating hospital readmission rates and length of stay among heart patients. Still another study currently close to completion is looking at the effect of ribose in controlling statin-induced myalgia.

Several things lead us to believe ribose will be effective in helping to relieve statin-induced myalgia. First, we know that ribose is effective in lessening muscle fatigue, cramping, soreness, and stiffness following strenuous exercise. We also know that a high percentage of

people with statin-induced muscle pain lack certain enzymes in their muscle that are related to energy metabolism. These things make clear the need to give ribose to patients taking statin drugs to support muscle energy synthesis.

Passwater: Let's return to Dr. Sinatra's "triad" once again. What role does each of the three nutrients play?

St. Cyr: Coenzyme Q-10 and L-carnitine are very important constituents of oxidative energy metabolism. CoQ-10, for example, is a major constituent in the electron transport chain of oxidative phosphorylation. It accepts electrons from other elements in the chain and passes them down the line, recycling ATP from ADP at every passing.

Carnitine is required by the cell to pass energy fuel across the inner mitochondrial membrane. Fatty acids are transported into the mitochondria by carnitine.

Both CoQ-10 and carnitine are important in energy turnover. However, they have no effect on actual synthesis of ATP. By contrast, ribose has a dramatic effect on ATP synthesis, but less impact on energy turnover. Further, CoQ-10 and carnitine need oxygen to be most effective. When cells are stressed by lack of oxygen, such as in heart disease, strenuous exercise, or certain forms of myalgia, oxidative energy turnover becomes less efficient. Ribose is most effective at these times in preserving the cellular energy pool.

Passwater: Are they synergistic with each other?

St. Cyr: There are tremendous synergies between ribose, CoQ-10 and L-carnitine. Remember, both the size of the energy pool and the efficiency of energy turnover are crucial to cellular bioenergetics. Ribose preserves the pool, while CoQ-10 and carnitine aid turnover. Both functions are optimally required.

Passwater: Dr. Sinatra talks about the benefit of these nutrients in the cardiac patient. Are there other patients who could benefit from these nutrients?

St. Cyr: Yes. Many patients with fibromyalgia and chronic fatigue syndrome, for example, can benefit. These patients are known to suffer fatigue and muscle pain associated with the loss of cellular energy. Further, many patients with less known muscle diseases, such as myoadenylate deaminase deficiency and McArdle's disease have noted marked improvement with ribose supplementation. And those with deficiencies in other energy-related enzymes, such as adenylosuccinase, also benefit.

Passwater: Should healthy people consider taking ribose supplements?

St. Cyr: As overwhelming as it seems, virtually 100% of the adult population may benefit from ribose administration. Certainly people with heart or muscle disease, or those at risk for these conditions can benefit. Athletes can benefit from the accelerated recovery ribose delivers. People who exercise more sporadically and face days of debilitating muscle pain

and fatigue following exercise can benefit. This covers about everyone.

Passwater: Where can people find out more about ribose?

St. Cyr: Valen Labs, Inc of Ham Lake, MN has a large patent portfolio covering many, many applications for ribose. They are best prepared to discuss the science and product. They can be contacted on the Internet at *www.corvalen.com*.

Passwater: Thank you, Dr. St. Cyr, for chatting with us about the health benefits of ribose.
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